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17JUN02 E726144-11 D02898
P01/7700 0.00-0213781.8

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Request for grant of a patent

(See the notes on the back of this form. You can also get an explanatory leaflet from the Patent Office to help you fill in this form)

1. Your reference — J3671(C)/PMK

2. Patent application number *(The Patent Office will fill in this part)* — 0213781.8 — 14 JUN 2002

3. Full name, address and postcode of the or of each applicant *(underline all surnames)*

   UNILEVER PLC
   UNILEVER HOUSE, BLACKFRIARS
   LONDON, EC4P 4BQ

   Patents ADP number *(if you know it)*

   If the applicant is a corporate body, give the country/state of its incorporation — UNITED KINGDOM 1628004

4. Title of the invention — DOMESTIC SPRAYING DEVICE

5. Name of your agent *(if you have one)* — ELLIOTT, Peter William

   "Address for Service" in the United Kingdom to which all correspondence should be sent *(including the postcode)*

   PATENT DEPARTMENT, UNILEVER PLC
   COLWORTH HOUSE, SHARNBROOK
   BEDFORD, MK44 1LQ

   Patents ADP number *(if you know it)* — 6573927001

6. If you are declaring priority from one or more earlier patent applications, give the country and the date of filing of the or of each of these earlier applications and *(if you know it)* the or each application number

Country	Priority application number *(if you know it)*	Date of filing *(day / month / year)*

7. If this application is divided or otherwise derived from an earlier UK application, give the number and the filing date of the earlier application

Number of earlier application	Date of filing *(day/month/year)*

8. Is a statement of inventorship and of right to grant of a patent required in support of this request? *(Answer 'Yes' if:*
   a) any applicant named in part 3 is not an inventor, or
   b) there is an inventor who is not named as an applicant, or
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Continuation sheets of this form	
Description	9
Claim(s)	2
Abstract	1
Drawing(s)	-

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Priority Documents	
Translations of priority documents	
Statement of inventorship and right to grant of a patent *(Patents Form 7/77)*	
Request for preliminary examination and search *(Patents Form 9/77)*	1
Request for substantive examination *(Patents Form 10/77)*	
Any other documents *(please specify)*	

11. I/We request the grant of a patent on the basis of this application.

Signature(s) Date: **14/06/02**

Sandra Jane EDWARDS, Authorised Signatory

12. Name and daytime telephone number of person to contact in the United Kingdom **Petra Kimber, Tel 01234 222893**

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Notes

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DOMESTIC SPRAYING DEVICE

The present invention relates to a hand-held domestic spraying device that utilises a MEMS (micro-electro mechanical system) pump to force a liquid composition from a reservoir towards a spray nozzle.

Hand-held domestic spraying devices of the prior art have utilised a variety of means for transferring a liquid composition from a storage reservoir towards a spray nozzle. A widely used option has been to use volatile propellants, such as liquefied hydrocarbons or chlorofluorocarbons, to pressurise the liquid composition. However, it is increasingly recognised that the addition to the atmosphere of VOCs/greenhouse gases may have detrimental environmental consequences.

An alternative means of supplying the necessary force to the liquid composition has been the use of hand-powered mechanical mechanisms, such as squeeze spray and trigger spray devices. Unfortunately, such mechanisms suffer the inherent problem of requiring physical effort on the part of the consumer. In addition, devices utilising such mechanisms tend not to produce good quality sprays.

The problems of the above approaches have been overcome by the use of electrically powered pumps. Such pumps may be used directly on the liquid composition or they may be used as air pumps - the resulting air pressure modification providing the force required to move the liquid composition.

EP 949,006 A1 (Procter and Gamble) describes the use of an electrically powered pump to directly move a liquid cleaning composition from a reservoir towards a spray nozzle. US 3,522,911 (Collins) and US 4,034,916 (Helene Curtis) describe the use of electrically powered air pumps as compressors, supplying pressurised air that is used to force a liquid composition from a reservoir towards a nozzle. WO 99/49904 (Quest International) describes the use of an electrically powered air pump to create an air stream that draws a liquid composition from a reservoir using a venturi effect.

The problem with electrically powered pumps, as described above, is that they are generally relatively expensive and bulky. In addition, their power consumption can be quite high. As a result, traditional electrically powered pumps are not ideal for use in disposable, hand-held, domestic spray devices. For this reason, devices that utilise such pumps have previously been envisaged as non-disposable devices, requiring re-fill packs of the liquid composition to be dispensed in order to be economically viable.

We now have found that a hand-held domestic spray device utilising an electrically powered pump may be made using a MEMS pump. Such devices have all the benefits of electrically powered pumps described above and the further benefits of being relatively inexpensive and light. In addition, the relatively low cost and size of such devices makes them potentially disposable and not tied to use with re-fill packs. A further advantage is that such devices can

produce a spray with very little noise; this can be a valuable benefit in the domestic environment.

MEMS pumps have previous been described for use in military and laboratory applications. WO 00/28215, US 5,836,750, US 6,106,245, and US 5,836,750 (all by Honeywell Inc.) describe such pumps and usage.

Summary of the Invention

In a first aspect of the present invention, there is provided a hand-held domestic spraying device comprising a reservoir for holding a liquid composition, a nozzle means for producing a spray from said liquid composition, an electrically powered pump for creating the force required to move the liquid composition from the reservoir towards the nozzle, and a control means for activating the electrically powered pump, characterised in that the electrically powered pump is a MEMS pump.

In a second aspect of the present invention, there is provided a method of spraying a liquid composition using a device as described in the first aspect of the invention.

In a third aspect of the invention, there is provided a device as described in the first aspect of the invention and a liquid composition for spraying therefrom.

Detailed description

The hand-held spraying device of the present invention may be used with numerous liquid compositions and for many domestic applications. It is particularly suitable for application of cosmetic compositions, which are generally applied directly to the human body. Examples of such cosmetic compositions include hair sprays, perfume sprays, deodorant body sprays and underarm products, in particular antiperspirant compositions. The MEMS pump provides a means of rapidly moving the liquid compositions from the reservoir towards the nozzle and thereby enables a good spray quality to be achieved at a high flow rate. A further benefit resulting from the use of an electrically powered MEMS pump is that the spray device is comparatively energy efficient, the MEMS pump having a relatively low power consumption. The above benefits are independently and collectively advantageous for liquid cosmetic compositions that have to be applied to the human body, where it is desirably to be able to apply the composition quickly in the form of a good quality spray and also to have a device that does not quickly run out of power.

Any type of MEMS pump may be used in the spray device of the invention. The pumps are characterised by comprising micro-channels having sub-millimeter diameters and operating using electrostatic pressure generation. Typical micro-channel diameters are from 1 to 500 µm, in particular from 10 to 300 µm. The pumps are typically fabricated using processes compatible with those used in semi-conductor integrated

silicones and plastics, with the proviso that the material must be capable of being electrically charged. The pumps may operate by positive displacement, the different principles being piston, gear, lobe, mohno, diaphragm, centrifugal, and hose. The use of diaphragm pumps, where liquid displacement is achieved by the deformation of an elastic membrane, is a preferred option. Micro-peristaltic pumps are another option.

Particularly preferred MEMS pumps for use in the present invention have a plurality of elementary cells, each of said cells comprising:

a body forming an electrode cavity having at least one electrode having a curved surface facing toward a curved surface on a facing part of said body to define said cavity, said body including electrical activation means for selectively energising said electrode;

a diaphragm mounted and grounded in said body under tension and having a major portion located in said cavity between said curved surfaces, said diaphragm being adapted to deflect toward and away from said electrode curved surface;

lateral conduit means in said body forming an end conduit, said lateral conduit means being operably connected to the portion of said diaphragm mounted in said body and positioned to be opened and closed by movement of said diaphragm for controlling flow of fluid through said end conduit;

vertical conduit means operatively connected to at least one curved surface of said cavity for controlling flow of fluid there through by movement of said diaphragm into and out of contact with said vertical conduit means; and

interconnecting conduit means for connecting said cell to said plurality of cells to form said MEMS pump;
whereby activation of said electrode causes movement of said diaphragm toward said curved surface of said electrode and deactivation of said electrode allows said diaphragm to return to its original position, to thereby move fluid into and out of said body.

In order to achieve a good transfer rate for the liquid composition, it is highly preferred to use an array of MEMS pumps arranged in parallel, optionally with output micro-channels combining together to give a single channel.

The MEMS pump may be used to act directly upon the liquid composition, forcing it towards the nozzle means. In such embodiments, the MEMS pump acts as a liquid pump and is situated either within or adjacent to the reservoir holding the liquid composition or is connected thereto by a conduit which provides for transfer of the liquid composition from the reservoir to the MEMS pump.

In alternative embodiments, the MEMS pump acts as an air pump and results in an air pressure modification adjacent to the liquid composition and thereby provides the force required to move the liquid composition towards the nozzle means.

In certain embodiments in which the MEMS pump acts as an air pump, its function is to act as an air compressor, increasing the air pressure adjacent to the liquid

forces it towards the nozzle means, often *via* a transfer conduit.

In other embodiments in which the MEMS pump acts as an air pump, it acts to create an air stream that serves to draw the liquid composition from the reservoir using a venturi effect. In such embodiments, the air flow creates a reduced pressure environment adjacent to the liquid composition, typically at the outer end of a transfer conduit contiguous with the reservoir for the liquid composition. The reduced pressure draws the liquid composition from the reservoir and into the air stream. In embodiments comprising a transfer conduit leading from the reservoir, the end of the transfer conduit may be considered to be part of the nozzle means (*vide infra*).

The nozzle means is responsible for creating and often directing the spray produced from the liquid composition. The nozzle means may be any of those typically used in the art, ranging from simple exit orifices to more complicated venturi atomisation nozzles. Preferred nozzles comprise a means of increasing droplet break-up beyond that achieved by the passage of the liquid composition through a simple exit orifice. Swirl chambers of the type known in the art are suitable for use in this manner.

The control means for activating the electrically powered pump may be of any appropriate form. Typical examples include push buttons, toggle switches, or slide-operated switches. The activation will typically involve supply of electrical power to the pump.

The source of the electrical power is preferably comprised within the device itself, although an external power supply may be used. The device may comprise a capacitor, battery or photo-voltaic cell as a source of electrical power.

In many embodiments there exists a transfer conduit for transfer of the liquid composition from the reservoir towards the nozzle means. The transfer conduit may have various positions relative to the MEMS pump. When the MEMS pump acts direct upon the liquid composition, the transfer conduit may be located between the reservoir and the pump, between the pump and the nozzle means, or there may be a transfer conduit in both of these locations. When the MEMS pump acts an air compressor, the transfer conduit runs from the reservoir to the nozzle means, the MEMS pump being separately located.

When present, the transfer conduit preferably comprises one or more valves. Such valves may function to prevent leakage of the liquid composition from the reservoir when the pump is not operating. Positive pressure on the reservoir side of the valve or negative pressure on the nozzle side of the valve may cause the opening of such valves.

The hand-held spraying devices of the present invention are able to achieve high fluid output, for example from 30 ml/hr. to 500 ml/hr., and, in particular, from 45 ml/hr. to 180 ml/hr., whilst still maintaining good spray quality. Spray quality may be defined by the fineness of the droplets achieved and/or by the narrowness of the particle size

desirable to achieve a volume mean particle size of from 1 μm to 100 μm, in particular from 5 μm to 50 μm, and especially from 5 μm to 25 μm.

Liquid compositions used with the device of the present invention frequently comprise a liquid carrier fluid comprising a C2 to C4 alcohol, for example ethanol, propylene glycol, propanol, or iso-propanol. When such liquid compositions are cosmetic compositions for application to the human body, the good spray quality attained leads to an excellent sensory benefit for the user. Suitable liquid compositions typically comprise C2 to C4 alcohol at a level of from 5% to 95%, in particular from 25% to 80%, and especially from 40% to 75% by weight of the composition. Liquid compositions comprising ethanol are particularly suitable for use with the device of the present invention.

The aforementioned liquid carrier fluid may also comprise water in an amount from 0.1% to 50% by weight of the composition.

CLAIMS

1. A hand-held domestic spraying device comprising a reservoir for holding a liquid composition, a nozzle means for producing a spray from said liquid composition, an electrically powered pump for creating the force required to move the liquid composition from the reservoir towards the nozzle, and a control means for activating the electrically powered pump, characterised in that the electrically powered pump is a MEMS pump.

2. A device according to claim 1, wherein the MEMS pump acts directly upon the liquid composition, forcing it towards the nozzle means.

3. A device according to claim 1, wherein the MEMS pump acts as an air pump resulting in an air pressure modification adjacent to the liquid composition and providing the force required to move the liquid composition from the reservoir towards the nozzle means.

4. A device according to claim 3, wherein the MEMS pump acts as air compressor, increasing the air pressure adjacent to the liquid composition.

5. A device according to claim 3, wherein the MEMS pump acts to create an air stream that serves to draw the liquid composition from the reservoir using a venturi

6. A device according to any of the preceding claims, comprising a transfer conduit for transfer of the liquid composition from the reservoir towards the nozzle means.

7. A device according to claim 6, wherein the transfer conduit comprises one or more valves.

ABSTRACT

A hand-held domestic spraying device comprising a reservoir for holding a liquid composition, a nozzle means for producing a spray from said liquid composition, an electrically powered pump for creating the force required to move the liquid composition from the reservoir towards the nozzle, and a control means for activating the electrically powered pump, characterised in that the electrically powered pump is a MEMS pump that gives the benefits of energy efficiency, low cost, and potential disposability.